Summer Oceanographic Measurements near the Mertz Polynya (140-150E) on NB Palmer Cruise 00-08

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LDEO-2003-3
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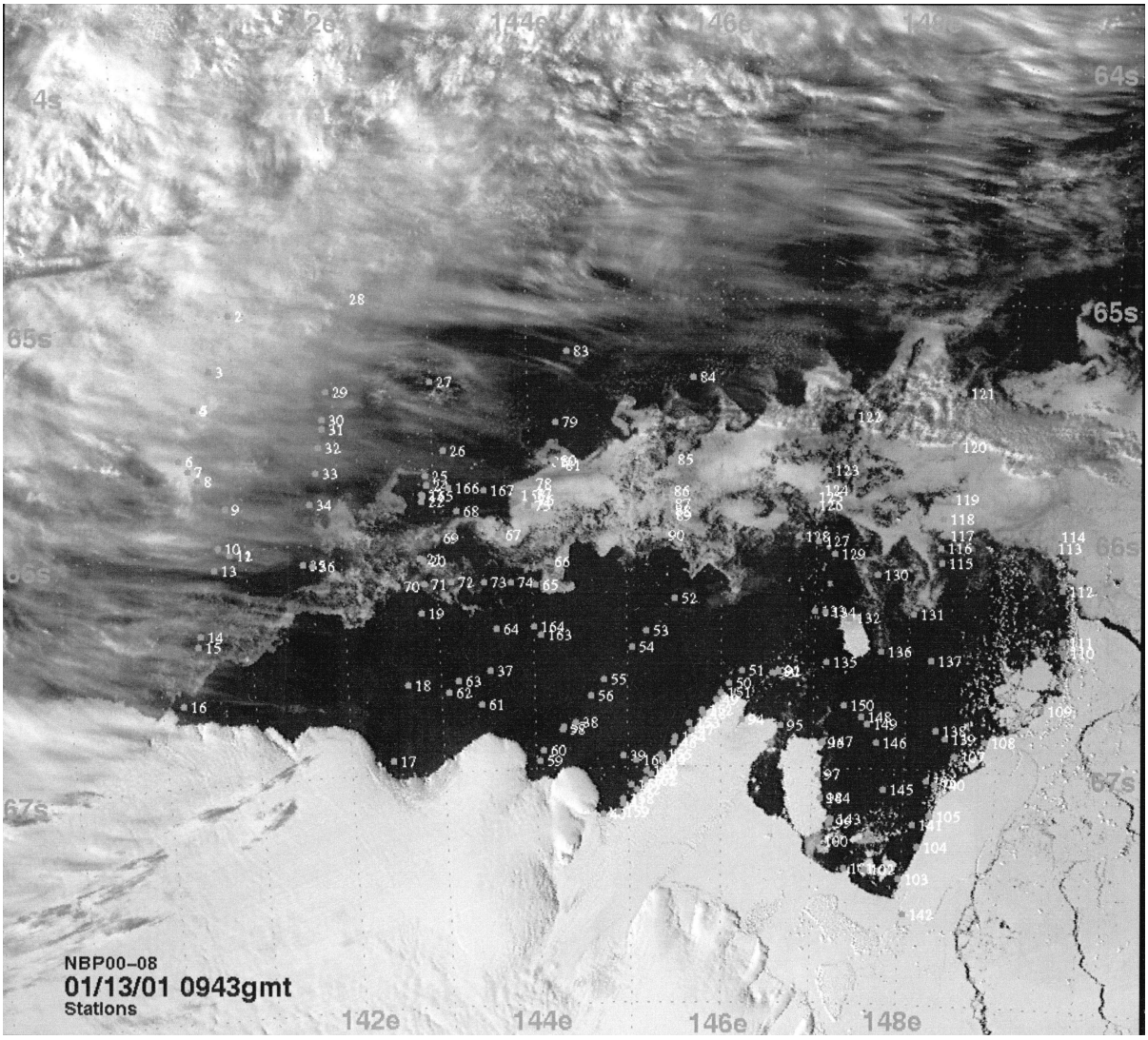

Fig. 1. A satellite image of the Mertz study area, with ocean station positions (see also figure 2) superimposed. During the course of work in this region, from 25 Dec 2000 to 19 Jan 2001, a band of sea ice moved WSW across the continental slope and rise (middle right) onto the outer shelf and toward the Antarctic coastline at left. Imagery by A Archer and J Shapiro.

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Background

We report physical and chemical oceanographic measurements along the George V Coast of East Antarctica, obtained during an early summer cruise of the *Nathaniel B. Palmer* (Fig. 1). The primary scientific objective of NBP00-08 was to continue an investigation of shelf and bottom water formation, initiated by an Australian group in the winter of 1999 along a section of the continental shelf believed to be dominated by the large and persistent Mertz Polynya. Like many similar coastal features, the winter Mertz Polynya results from the combined influence of strong katabatic (gravity drainage) winds from the Antarctic Ice Sheet and a promontory, in this case the Mertz Glacier Tongue (MGT), which blocks the generally westward drift of sea ice along the coastline. This complementary summer cruise began on 20 December 2000 in Hobart, Tasmania, and ended there on 25 January 2001. Both outbound and inbound tracks diverted from great circle routes to and from our study area in order to make underway magnetic, gravity and bathymetric observations for S Cande (Scripps Institution of Oceanography) and J Stock (California Institute of Technology) related to questions posed by a large intraplate earthquake that occurred seaward of the continental shelf in March, 1998.

More than 165 CTD/rosette casts were made in the 140-150E region south of 65S, roughly aligned in several north-south transects (Fig. 2). Many stations were occupied within several hundred meters of the MGT, other grounded or floating icebergs, along the fast ice edge and in the drifting pack ice. Adjunct Lamont projects with NSF support to R Sambrotto and R Vaillancourt, and to T Takahashi and C Sweeney, sampled for biological productivity and made nearly continuous underway pCO_2 measurements. With additional support from NASA and NOAA, water samples were taken and processed aboard ship for chlorofluorocarbon (CFC) content. Shallow stations were occupied for productivity work and to bracket short Mocness trawls. Here we describe data acquisition and reduction procedures for the CTD measurements, and the processing of rosette water samples for salinity, dissolved oxygen, silicate, phosphate, nitrate, oxygen isotopes and CFCs. Not included in the data presented

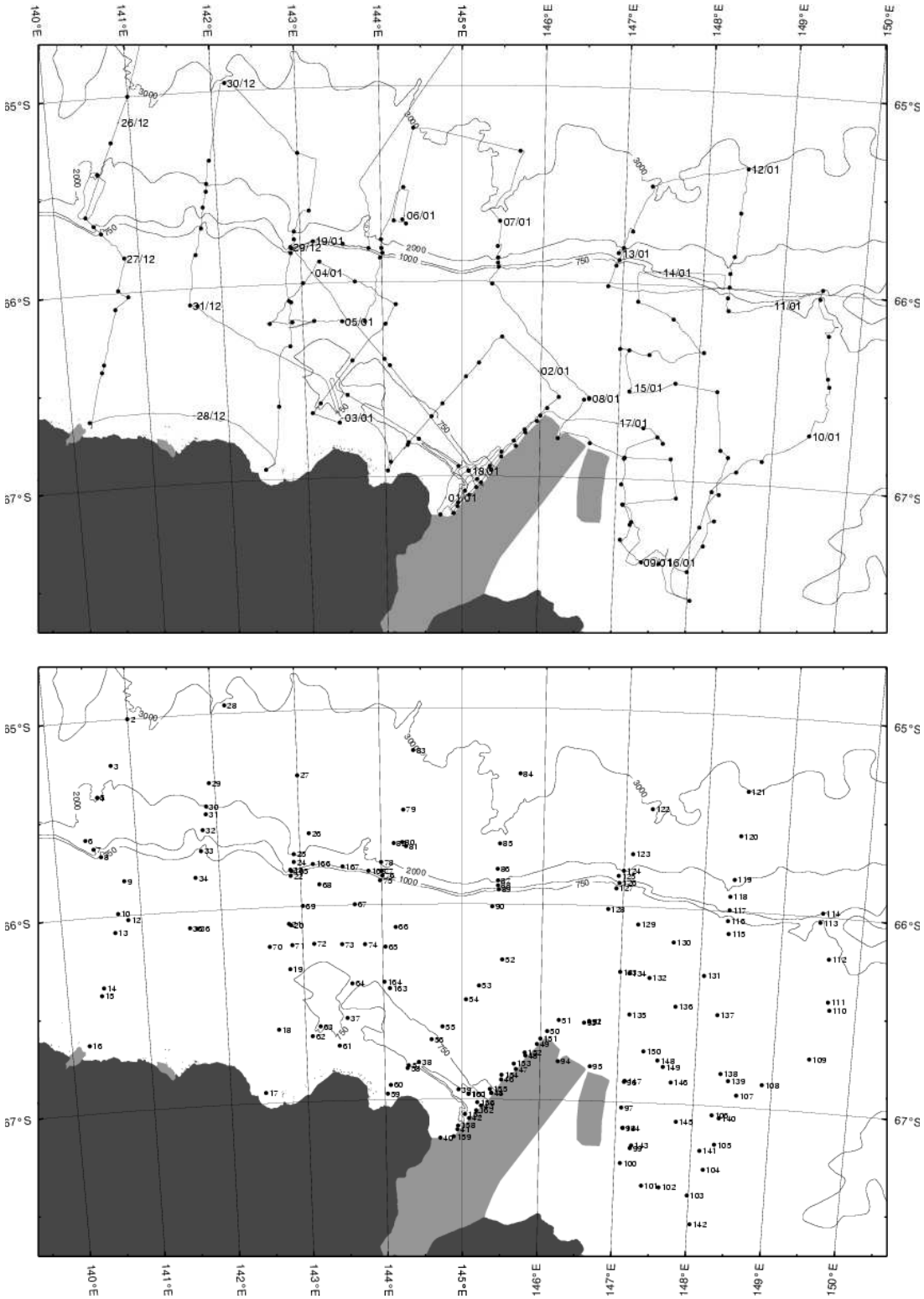

Fig. 2. Ship track with datelines (top panel) and ocean station numbers (bottom panel) in the Mertz Glacier Tongue (light gray projection from coastline at bottom) study area. For more detailed bathymetry see Chase et al (1987), or http://data.ldeo.columbia.edu/world/ for NBP00-08 data.

here are measurements of chlorophyll-a, ammonia or iron, vertical profiles of fluorescence, PAR and light transmission, or the underway pCO_2 observations.

We encountered a more extensive sea ice field than anticipated over the outer shelf and slope (Fig. 1). Access to the eastern portion of the proposed study region was also slowed or precluded by fast ice and hundreds of stalled and grounded icebergs (see also Massom 2003), which blocked the drift of summer ice upstream (east) of the MGT. The glacier tongue extended farther north than in the historical record, and may have been grounded near its northern end on a shallow bank. The sea floor was swath-mapped throughout the region, with data quality strongly dependent on sea ice cover and sea state. The Adelie Trough (Depression) was found to be deeply grooved and arcing SE under the MGT. A probable similar trough reaching under the Ninnis Glacier (Chase et al 1987) was inaccessible due to multiyear fast ice. Sills occur on the outer shelf east and west of the end of the MGT, but canyons are not as well developed on the continental slope as illustrated on the Chase et al chart.

CTD Data Acquisition & Processing

A SeaBird 911*plus* system was used for the CTD measurements at the locations indicated in figure 2 and table 1. Dual temperature and conductivity sensors were sampled at a rate of 24Hz, with seawater pumped past the sensors. Prior to lowering on each station, the sensors were briefly equilibrated with the near-surface environment, and near-bottom data were obtained with the aid of a 12kHz pinger and bottom contact switch. Sensors were flushed and the oxygen probe chilled with ice between stations. CTD data were processed with Seasoft version 5.26 software, generally following standard procedures (www.seabird.com). We report both descending and ascending profiles because rosette bottles are closed at stops during the CTD ascent, and valid spatial and/or temporal differences often occur during the time of a single station (e.g., see station 22).

Table 1. CTD station locations and surface variables at the start of each cast on NBP00-08. Water depth (DPTH) is corrected meters, and DCTD indicates the maximum depth of CTD measurement. Other parameters are defined prior to the station listings.

STA	YEAR/MO/DA	GMT	LATITUDE	LONGITUDE	DPTH	DCTD	AIRT	RELH	SEATEM	SEASAL	BAROM	WND	WNS
2	2000/12/25	19:47	-65.0001	141.0006	2802	2793	-1.3	90.2	-0.71	33.902	987.0	149	15.8
3	2000/12/26	01:07	-65.2317	140.7583	2253	2261	-1.4	88.3	-0.94	33.949	988.5	139	18.8
4	2000/12/26	09:38	-65.3886	140.5687	1986	100	-1.1	92.8	-0.98	33.976	994.1	116	14.3
5	2000/12/26	09:54	-65.3873	140.5696	2005	2014	-1.0	92.7	-0.98	33.976	994.1	116	14.4
6	2000/12/26	14:53	-65.6022	140.3832	1562	1551	-0.9	88.5	-1.02	34.043	996.6	120	11.8
7	2000/12/26	17:50	-65.6510	140.4714	1034	1016	-0.9	86.8	-0.98	34.038	997.3	125	9.8
8	2000/12/26	20:19	-65.6915	140.5584	570	589	-0.7	83.7	-0.95	34.057	998.1	121	9.6
9	2000/12/26	23:42	-65.8235	140.8196	305	297	0.0	79.9	-0.96	34.097	998.3	130	10.2
10	2000/12/27	02:51	-65.9884	140.7122	218	109	-0.1	79.6	-0.96	34.139	998.9	121	10.4
12	2000/12/27	05:57	-66.0219	140.8345	227	102	-0.4	83.1	-0.98	34.169	999.0	118	8.1
13	2000/12/27	07:47	-66.0830	140.6615	230	224	0.3	80.2	-0.96	34.157	999.3	127	7.1
14	2000/12/27	11:43	-66.3616	140.4677	546	537	0.5	61.2	-0.82	34.289	998.8	138	11.8
15	2000/12/27	13:14	-66.4009	140.4327	1016	990	-0.1	61.6	-1.00	34.289	998.7	133	12.6
16	2000/12/27	18:08	-66.6513	140.2233	1400	1381	-1.7	57.7	-1.24	34.440	998.6	151	16.0
17	2000/12/28	04:31	-66.9474	142.4540	827	818	2.8	56.7	-0.69	34.268	999.3	162	13.4
18	2000/12/28	08:38	-66.6265	142.6553	787	833	2.0	70.8	-0.90	34.142	1001.0	111	7.7
19	2000/12/28	12:15	-66.3178	142.8286	503	492	1.0	75.0	-1.13	33.910	1002.0	142	11.2
20	2000/12/28	15:38	-66.0945	142.8594	491	490	-0.8	86.5	-1.70	33.744	1004.0	161	3.8
21	2000/12/28	17:05	-66.0869	142.8330	478	50	0.3	81.9	-1.69	33.744	1005.0	166	4.1
22	2000/12/28	21:32	-65.8418	142.8766	633	576	0.5	84.5	-1.22	33.788	1007.0	160	2.8
23	2000/12/28	23:32	-65.8109	142.8751	1136	1131	0.9	81.7	-1.07	33.874	1008.0	214	2.8
24	2000/12/29	02:16	-65.7707	142.9227	1660	1663	1.4	75.7	-0.71	33.893	1009.0	211	5.4
25	2000/12/29	06:04	-65.7324	142.9231	2023	2019	2.0	76.8	-0.68	33.907	1009.0	252	4.4
26	2000/12/29	10:05	-65.6280	143.1192	2477	2476	0.6	73.5	-0.72	33.823	1009.0	188	2.4
27	2000/12/29	17:16	-65.3309	143.0014	2931	2930	-0.9	77.3	-0.54	33.960	1008.0	165	3.7
28	2000/12/29	23:54	-64.9588	142.1614	2974	2978	1.5	55.6	-0.28	33.939	1006.0	128	3.3
29	2000/12/30	05:58	-65.3509	141.9299	2347	2339	-1.5	71.8	-0.25	33.996	1003.0	93	5.2

30	2000/12/30	09:14	-65.4692	141.8788	1977	149	-1.3	78.8	-0.25	33.986	1001.0	78	3.7
31	2000/12/30	10:44	-65.5087	141.8701	1863	1854	-1.4	81.7	-0.49	34.023	999.5	99	4.8
32	2000/12/30	13:50	-65.5880	141.8248	1268	1343	-1.7	82.6	-0.68	34.002	997.5	61	4.9
33	2000/12/30	17:15	-65.6942	141.7874	691	681	-1.6	85.6	-0.95	33.797	995.8	72	5.9
34	2000/12/30	20:22	-65.8301	141.7012	389	381	-2.0	90.7	-1.18	33.721	995.3	100	3.6
35	2000/12/30	23:59	-66.0845	141.5979	241	237	-1.8	93.1	-0.86	33.890	995.7	104	7.7
36	2000/12/31	02:55	-66.0911	141.6896	247	100	-1.2	87.3	-0.99	33.929	996.1	97	6.4
37	2000/12/31	14:21	-66.5772	143.5348	724	713	-2.5	90.2	-0.95	33.988	996.3	120	8.8
38	2000/12/31	18:13	-66.8079	144.4388	970	968	-2.5	87.6	-0.79	34.120	996.0	144	9.9
39	2000/12/31	21:35	-66.9500	144.9500	1058	1048	-2.7	85.8	-0.75	34.210	996.6	163	7.5
40	2001/01/01	01:35	-67.1973	144.7136	345	431	-0.7	71.3	-1.10	34.336	996.8	353	0.9
41	2001/01/01	04:38	-67.1550	144.9361	719	714	0.5	66.8	-0.70	34.178	995.9	150	5.0
42	2001/01/01	06:15	-67.0966	145.0875	1149	1136	-0.0	73.9	-0.75	34.139	995.4	171	4.3
43	2001/01/01	08:37	-67.0336	145.2428	1125	1115	0.3	72.0	-0.70	34.163	994.8	171	5.4
44	2001/01/01	10:29	-66.9685	145.3762	846	166	-0.4	73.8	-0.75	34.178	994.5	154	6.6
45	2001/01/01	11:41	-66.9670	145.3755	850	843	-1.1	70.5	-0.76	34.182	994.3	162	7.5
46	2001/01/01	13:36	-66.8979	145.4995	640	629	-1.9	83.8	-1.03	34.261	994.2	142	8.1
47	2001/01/01	15:13	-66.8440	145.6894	503	496	-1.9	84.7	-0.90	34.176	993.8	127	6.4
48	2001/01/01	17:27	-66.7750	145.8113	435	428	-1.7	84.3	-0.85	34.023	994.0	131	5.5
49	2001/01/01	18:48	-66.7152	145.9567	347	337	-1.4	87.9	-1.21	34.209	994.1	145	6.7
50	2001/01/01	20:45	-66.6471	146.0837	285	272	-1.3	83.2	-0.91	34.096	994.9	113	7.9
51	2001/01/01	21:56	-66.5893	146.2308	223	216	-1.0	79.5	-1.04	34.212	994.7	126	7.7
52	2001/01/02	01:50	-66.2832	145.4997	212	205	-0.8	80.6	-1.19	33.659	995.6	128	6.2
53	2001/01/02	04:03	-66.4176	145.2086	386	379	-1.4	85.2	-1.25	33.718	995.2	134	8.4
54	2001/01/02	05:22	-66.4898	145.0480	416	410	-1.0	80.0	-1.18	33.819	996.0	136	7.1
55	2001/01/02	07:49	-66.6279	144.7467	612	598	-1.0	79.1	-0.75	33.990	995.5	127	8.0
56	2001/01/02	09:37	-66.6923	144.6031	834	821	-1.4	83.0	-0.86	33.936	995.5	140	8.8
57	2001/01/02	11:54	-66.8256	144.3096	680	742	-1.8	80.2	-0.76	34.185	994.9	134	10.2
58	2001/01/02	14:07	-66.8387	144.2918	497	493	-1.9	84.7	-0.78	34.206	993.7	136	10.8
59	2001/01/02	16:53	-66.9698	144.0347	784	131	-2.8	73.4	-0.65	34.131	992.8	153	10.9
60	2001/01/02	20:02	-66.9251	144.0751	939	931	-2.8	77.6	-0.78	34.131	991.7	157	12.0
61	2001/01/03	00:36	-66.7184	143.4281	443	459	-1.8	77.2	-0.79	34.048	989.1	135	18.4
62	2001/01/03	02:54	-66.6642	143.0836	714	706	-0.8	75.3	-0.82	34.002	989.2	119	16.2
63	2001/01/03	04:40	-66.6162	143.1874	817	812	-1.0	84.3	-0.84	33.999	989.1	120	16.8
64	2001/01/03	07:29	-66.4010	143.6097	662	644	-0.7	82.1	-0.98	33.849	989.2	121	14.1
65	2001/01/03	10:30	-66.2152	144.0353	428	415	-1.1	82.4	-1.68	33.508	989.8	128	13.3
66	2001/01/03	13:35	-66.1170	144.1677	378	364	-1.3	89.0	-1.68	33.511	990.6	130	3.8
67	2001/01/03	18:05	-65.9962	143.6595	423	417	-1.4	90.8	-1.67	33.380	991.0	128	3.4
68	2001/01/03	21:59	-65.8890	143.2302	436	421	-0.9	91.4	-1.59	33.498	990.6	111	3.7
69	2001/01/04	01:06	-65.9975	143.0145	464	449	-0.9	90.1	-1.61	33.598	989.1	106	6.2
70	2001/01/04	04:24	-66.2007	142.5847	338	330	-1.7	92.8	-1.63	33.590	986.5	109	7.2
71	2001/01/04	07:51	-66.1965	142.8682	524	510	-1.9	93.3	-1.46	33.733	982.0	112	8.9
72	2001/01/04	11:48	-66.1926	143.1419	594	546	-1.9	94.4	-1.55	33.636	975.3	123	21.2
73	2001/01/04	23:30	-66.1988	143.4892	550	540	-0.6	88.9	-1.71	33.465	972.3	330	4.4
74	2001/01/05	03:03	-66.2012	143.7785	475	466	0.1	92.6	-1.72	33.542	975.0	349	3.6
75	2001/01/05	08:35	-65.8764	143.9825	516	508	0.2	96.4	-1.65	33.412	975.7	38	6.0
76	2001/01/05	10:11	-65.8524	144.0132	1079	1100	0.1	96.8	-1.68	33.358	975.4	55	6.5
77	2001/01/05	12:18	-65.8276	143.9978	1552	1569	-0.2	97.0	-1.67	33.309	975.0	66	5.1
78	2001/01/05	14:44	-65.7832	143.9970	2039	1972	-0.4	97.4	-1.64	33.285	974.6	75	4.1
79	2001/01/05	19:47	-65.5184	144.2781	2699	2690	-0.4	97.2	-0.66	33.641	974.8	131	8.0
80	2001/01/06	00:29	-65.6825	144.2611	2342	119	-0.2	97.1	-1.36	33.319	977.1	143	7.2
81	2001/01/06	02:58	-65.7043	144.3066	2610	121	0.0	96.1	-1.34	33.276	978.5	143	9.0
82	2001/01/06	04:03	-65.6879	144.1584	2540	2536	-0.1	95.8	-1.26	33.402	979.4	140	8.8
83	2001/01/06	09:15	-65.2155	144.4078	2953	2940	-0.3	95.0	-0.16	33.847	982.0	146	7.8
84	2001/01/06	15:30	-65.3331	145.7054	3187	3178	-0.8	93.5	-0.03	33.799	985.4	187	5.4
85	2001/01/06	22:22	-65.6907	145.4652	2928	2921	-0.2	87.2	-1.49	33.160	988.4	292	6.1
86	2001/01/07	03:35	-65.8215	145.4358	2533	2526	0.1	89.6	-1.73	33.326	989.2	274	5.5
87	2001/01/07	07:23	-65.8790	145.4423	2036	2088	-0.3	85.2	-1.74	33.375	989.4	272	4.9
88	2001/01/07	10:16	-65.9052	145.4406	1370	1446	-0.9	87.9	-1.71	33.351	989.9	274	4.5
89	2001/01/07	12:31	-65.9265	145.4491	753	762	-1.2	87.4	-1.73	33.356	990.3	274	5.0
90	2001/01/07	15:04	-66.0136	145.3722	363	357	-1.4	89.4	-1.76	33.382	990.2	269	5.3
91	2001/01/07	22:46	-66.5912	146.6183	406	400	-2.8	59.2	-0.55	34.136	991.2	239	7.7
92	2001/01/08	00:22	-66.5954	146.6198	406	147	-2.9	58.1	-0.42	34.107	991.4	264	7.6
93	2001/01/08	02:45	-66.6008	146.5529	385	199	-1.2	56.4	-0.66	34.116	991.3	248	7.7
94	2001/01/08	04:58	-66.8007	146.2273	356	349	0.5	61.4	-0.98	34.105	990.7	284	5.9
95	2001/01/08	07:27	-66.8219	146.6454	530	519	0.3	68.1	-0.01	34.098	990.2	320	4.2
96	2001/01/08	09:58	-66.8968	147.0894	571	564	0.0	72.4	-0.12	34.024	988.9	310	2.6
97	2001/01/08	12:21	-67.0286	147.0676	556	548	-1.1	66.6	-0.39	34.157	987.7	140	4.5
98	2001/01/08	14:21	-67.1329	147.0954	523	517	-2.4	80.2	0.25	34.087	986.9	148	8.1
99	2001/01/08	16:43	-67.2352	147.1976	478	471	-2.7	87.3	-0.22	34.071	986.1	132	7.4
100	2001/01/08	19:37	-67.3138	147.0741	501	489	-2.8	82.4	-0.57	34.110	985.6	131	10.0
101	2001/01/08	22:27	-67.4255	147.3652	475	467	-1.8	82.6	-0.85	34.164	986.1	120	9.1
102	2001/01/09	01:28	-67.4309	147.5999	537	529	-0.5	76.5	-0.59	34.257	985.3	115	8.0
103	2001/01/09	07:33	-67.4653	147.9795	533	523	-0.6	78.9	-0.18	34.086	986.2	135	7.5
104	2001/01/09	09:50	-67.3281	148.1725	440	436	-1.6	84.4	-0.40	34.014	986.5	155	5.6
105	2001/01/09	12:10	-67.1967	148.3021	492	478	-2.0	84.8	-0.93	34.090	987.0	177	4.6
106	2001/01/09	14:29	-67.0479	148.2480	463	458	-1.6	81.2	-0.60	33.929	987.4	162	5.8
107	2001/01/09	17:05	-66.9399	148.5508	490	483	-2.0	81.2	-1.09	34.140	987.7	163	3.1
108	2001/01/09	19:40	-66.8768	148.8709	618	615	-2.9	84.1	-1.58	34.344	988.3	200	4.6
109	2001/01/09	23:05	-66.7282	149.4579	556	546	-1.1	73.8	-1.40	34.219	988.6	252	3.8
110	2001/01/10	03:19	-66.4716	149.6658	540	529	1.9	71.2	-0.94	34.165	988.4	282	1.7
111	2001/01/10	06:14	-66.4308	149.6374	522	119	-0.2	74.3	-0.60	34.193	987.3	237	4.0
112	2001/01/10	09:08	-66.2113	149.6080	479	477	0.9	74.0	-1.11	33.966	987.0	205	1.8
113	2001/01/10	14:20	-66.0274	149.4651	586	579	-3.8	90.5	-1.76	34.134	985.6	102	0.7
114	2001/01/10	16:52	-65.9805	149.4898	968	961	-5.2	92.4	-1.82	34.016	985.3	159	2.7
115	2001/01/11	03:04	-66.1165	148.3298	270	262	-1.7	80.3	-1.55	33.529	988.5	175	2.0
116	2001/01/11	05:13	-66.0505	148.3149	547	539	-2.3	85.2	-1.61	33.572	989.1	185	1.4
117	2001/01/11	07:12	-65.9948	148.3259	1003	1002	-1.4	84.4	-1.70	33.633	989.7	217	0.7
118	2001/01/11	09:53	-65.9261	148.3270	1580	1583	-2.2	87.0	-1.80	33.635	990.5	244	1.9
119	2001/01/11	12:45	-65.8386	148.3664	2227	2262	-2.5	85.5	-1.71	33.300	991.1	256	2.8

120	2001/01/11	18:11	-65.6144	148.4155	2505	2498	-3.1	77.3	-1.76	33.295	991.8	288	2.2
121	2001/01/11	23:53	-65.3859	148.4756	2984	2981	-2.2	69.7	-0.33	33.285	993.2	279	2.4
122	2001/01/12	10:03	-65.4986	147.3233	2949	2945	-3.2	71.7	-1.72	32.952	994.5	290	2.8
123	2001/01/12	16:01	-65.7310	147.1012	2601	2613	-6.0	79.2	-1.55	32.999	996.4	262	3.1
124	2001/01/12	19:58	-65.8173	146.9940	1975	1970	-4.0	69.7	-1.76	33.396	997.9	174	2.5
125	2001/01/12	22:38	-65.8441	146.9349	1446	1474	-2.7	76.6	-1.75	33.408	998.7	199	2.0
126	2001/01/13	05:58	-65.8801	146.9439	986	925	-1.9	62.4	-1.68	33.298	997.3	187	1.2
127	2001/01/13	08:01	-65.9084	146.9090	487	484	-0.3	60.2	-1.56	33.179	996.5	103	0.6
128	2001/01/13	10:30	-66.0146	146.8142	296	280	-1.6	70.0	-1.44	33.331	995.5	94	1.1
129	2001/01/14	03:28	-66.0900	147.1983	481	473	-2.2	92.8	-1.08	33.464	981.6	107	19.5
130	2001/01/14	07:02	-66.1731	147.6486	522	498	-1.8	92.5	-1.45	33.462	978.9	103	20.5
131	2001/01/14	11:30	-66.3364	148.0542	581	570	-2.1	89.8	-1.49	33.416	977.3	99	20.5
132	2001/01/14	16:26	-66.3600	147.3643	589	576	-2.5	90.8	-1.50	33.423	974.8	110	22.4
133	2001/01/14	19:28	-66.3349	146.9904	335	317	-2.1	91.7	-1.11	33.682	974.1	113	16.6
134	2001/01/14	20:45	-66.3396	147.1091	482	474	-2.0	91.0	-1.30	33.528	974.5	109	18.8
135	2001/01/15	00:28	-66.5518	147.1289	574	562	-1.3	89.8	-1.03	33.662	976.5	108	19.0
136	2001/01/15	03:25	-66.5017	147.7094	604	597	-1.4	90.5	-1.34	33.481	976.9	116	14.8
137	2001/01/15	05:44	-66.5330	148.2504	341	336	-1.3	90.6	-1.10	33.747	976.8	119	15.1
138	2001/01/15	08:50	-66.8333	148.3334	406	406	-1.4	90.4	-1.07	33.970	977.6	126	15.8
139	2001/01/15	11:24	-66.8677	148.4318	283	153	-1.6	90.9	-0.98	34.035	977.4	133	15.1
140	2001/01/15	13:28	-67.0615	148.3437	488	482	-2.0	91.0	-1.37	34.201	977.5	132	14.1
141	2001/01/15	16:30	-67.2336	148.1121	404	398	-2.2	90.8	-0.91	34.148	977.7	137	14.9
142	2001/01/15	21:04	-67.6122	148.0364	514	506	-1.2	88.7	-1.72	34.235	978.8	144	13.7
143	2001/01/16	04:44	-67.2204	147.2159	473	463	1.0	75.7	-0.62	33.968	977.4	159	12.5
144	2001/01/16	06:45	-67.1327	147.0945	523	517	0.8	78.4	-0.64	33.846	977.4	158	13.1
145	2001/01/16	09:37	-67.0906	147.7857	510	504	-0.1	83.8	-0.67	33.925	976.9	144	13.5
146	2001/01/16	12:07	-66.8907	147.6966	606	593	-0.4	84.8	-0.46	33.877	977.5	154	14.6
147	2001/01/16	14:31	-66.8916	147.1000	584	574	-0.5	85.7	-0.29	34.092	978.9	150	12.2
148	2001/01/16	17:23	-66.7815	147.5122	641	147	-0.9	86.8	-0.57	33.909	978.7	148	11.7
149	2001/01/16	20:17	-66.8117	147.5840	633	147	-0.9	85.9	-0.44	34.025	979.4	143	10.5
150	2001/01/16	21:52	-66.7367	147.3274	626	621	-0.7	86.5	-0.29	34.089	979.7	150	9.4
151	2001/01/17	02:52	-66.6861	145.9978	335	327	0.0	84.4	-0.88	33.616	981.3	162	8.9
152	2001/01/17	04:39	-66.7595	145.7992	432	424	-0.2	86.5	-0.89	33.742	981.8	153	7.8
153	2001/01/17	06:08	-66.8164	145.6622	498	490	0.4	78.9	-0.96	33.937	982.1	170	7.8
154	2001/01/17	07:22	-66.8749	145.5052	618	612	1.1	75.3	-0.97	34.130	982.0	191	5.9
155	2001/01/17	09:17	-66.9474	145.3554	830	817	0.9	73.7	-0.97	34.024	981.9	199	6.2
156	2001/01/17	11:01	-67.0160	145.1924	1177	1170	0.5	75.2	-0.92	34.057	982.0	166	8.5
157	2001/01/17	13:18	-67.0760	145.0343	1126	1121	-0.7	74.9	-1.09	34.245	982.4	144	9.2
158	2001/01/17	14:56	-67.1350	144.9443	642	634	-2.5	78.0	-1.16	34.298	982.6	137	7.3
159	2001/01/17	17:10	-67.1913	144.8876	648	646	-1.4	82.6	-1.35	34.334	982.8	187	5.1
160	2001/01/17	22:46	-66.9728	145.0792	1090	148	-0.3	88.6	-0.72	33.847	982.8	141	8.4
161	2001/01/17	23:56	-66.9720	145.0830	1083	58	0.1	86.4	-0.68	33.830	982.9	140	8.2
162	2001/01/18	05:07	-67.0571	145.1790	1313	1307	-0.0	90.4	-0.91	34.102	983.2	161	3.3
163	2001/01/18	11:12	-66.4297	144.0809	583	575	-0.3	91.1	-0.82	33.567	983.9	144	5.7
164	2001/01/18	13:30	-66.3950	144.0152	558	147	-0.2	85.4	-0.99	33.516	984.4	146	3.3
165	2001/01/18	19:31	-65.8182	142.8898	955	982	-1.3	90.5	-1.19	33.176	988.0	260	3.9
166	2001/01/18	22:57	-65.7858	143.1578	1007	1034	-0.7	88.9	-1.56	33.074	990.0	256	2.4
167	2001/01/19	02:14	-65.8017	143.5195	1061	1102	0.0	86.4	-1.41	32.835	991.4	257	3.0
168	2001/01/19	05:43	-65.8277	143.8395	938	980	-0.7	91.1	-1.55	32.982	992.8	255	3.3

The temperature and conductivity sensors were calibrated by SeaBird before and after the cruise (Table 2). The data reported here are from the secondary sensors. Temperatures were corrected by linear interpolation between pre- and post-cruise calibrations, which revealed a drift of 0.00061°C over 209 days. Conductivity was corrected by applying post-cruise calibration coefficients, followed by a linear fit to water sample measurements. A subset of 824 salinity samples having conductivities within ~0.0025 of the CTD conductivity provided slope and bias corrections of 0.00016 and –0.0023 for the CTD data. A 5-point median filter was applied after the data were averaged into 1 dbar bins. Potential temperature, in-situ freezing point, salinity and density were computed from UNESCO (1981, 1983) algorithms.

Table 2. CTD sensors and calibration data for NBP00-08.

Sensor	**Description**	**Serial Number**	**Cal. Pre**	**Cal. Post**
Pressure	SeaBird SBE 9+	094857-43528	3/30/99	2/13/01
Temperature, Primary	SeaBird 3plus	03P2438	8/20/99	2/14/01
Temperature, Secondary	SeaBird 3plus	03P2308	7/20/00	2/13/01
Conductivity, Primary	SeaBird 4C	41852	5/18/00	2/13/01
Conductivity, Secondary	SeaBird 4C	42067	7/20/00	2/13/01
Dissolved Oxygen	SeaBird 13-02-B	130488	3/01/00	

CTD oxygen data, acquired with a Beckman type sensor, were processed with pre-cruise calibration coefficients, using Millard (1993) algorithms. The resulting values were adjusted separately on the descent and ascent profiles to water samples titrated for dissolved oxygen, as described below, and smoothed with a 5-point gaussian filter. Both profiles are reported, except for station 32, and tend to display larger hysteresis or equilibration anomalies on the shallow stations. The NBP00-08 CTD oxygen data vs potential temperature are consistent with scattered WOCE measurements, mostly north of the shelf, except at higher temperatures (Fig 3). The Glacier-79 CTD data were doubtful when reported, as bottle oxygen measurements were lacking on those stations (Jacobs & Haines 1982), and now appear systematically high in a similar comparison (Fig 3).

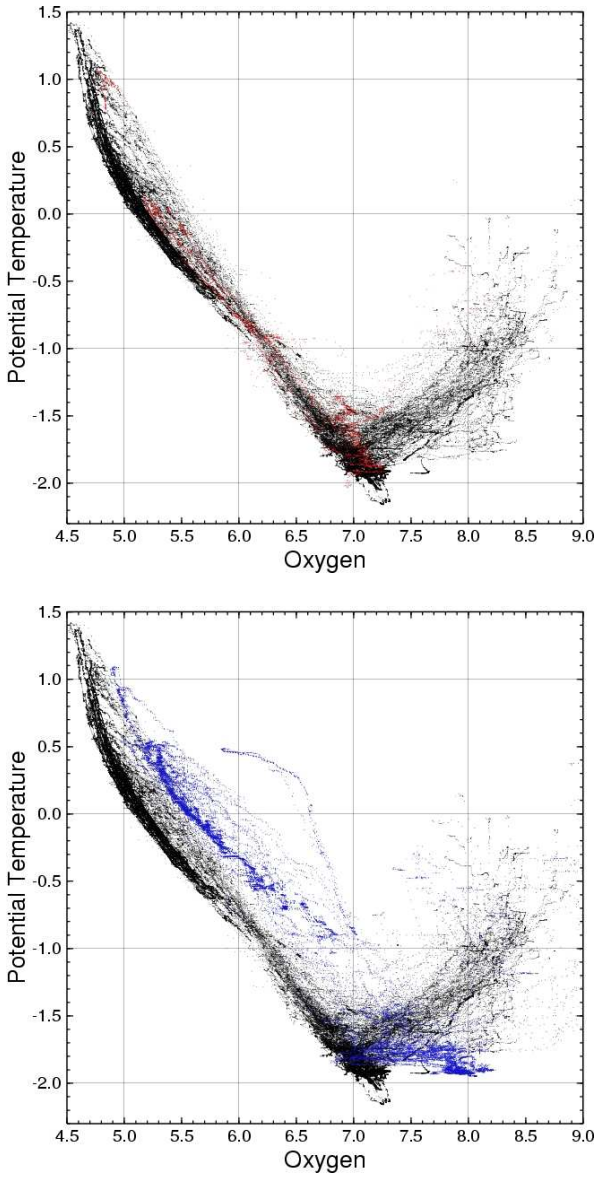

Fig. 3. CTD oxygen vs potential temperature for NBP00-08 (black) vs WOCE CTD (red in top panel) and Glacier-79 CTD (blue in bottom panel) in the same region.

ADCP data Acquisition and Processing

Ship-mounted Acoustic Doppler Current Profiler (ADCP) profiles were made over the upper 300-400m of the water column, as part of an ongoing project under the direction of E Firing (Univ of Hawaii) and T Chereskin (Scripps Institution of Oceanography). Except during work in the sea ice, when reliable measurements could only be obtained on station, good quality 5 minute average profiles were obtained throughout the cruise. In figure 4, six-hour averaged currents are shown for depths of 100, 200 and 300m. A more complete description of the ADCP project may be accessed at http://currents.soest.hawaii.edu/nbpalmer/.

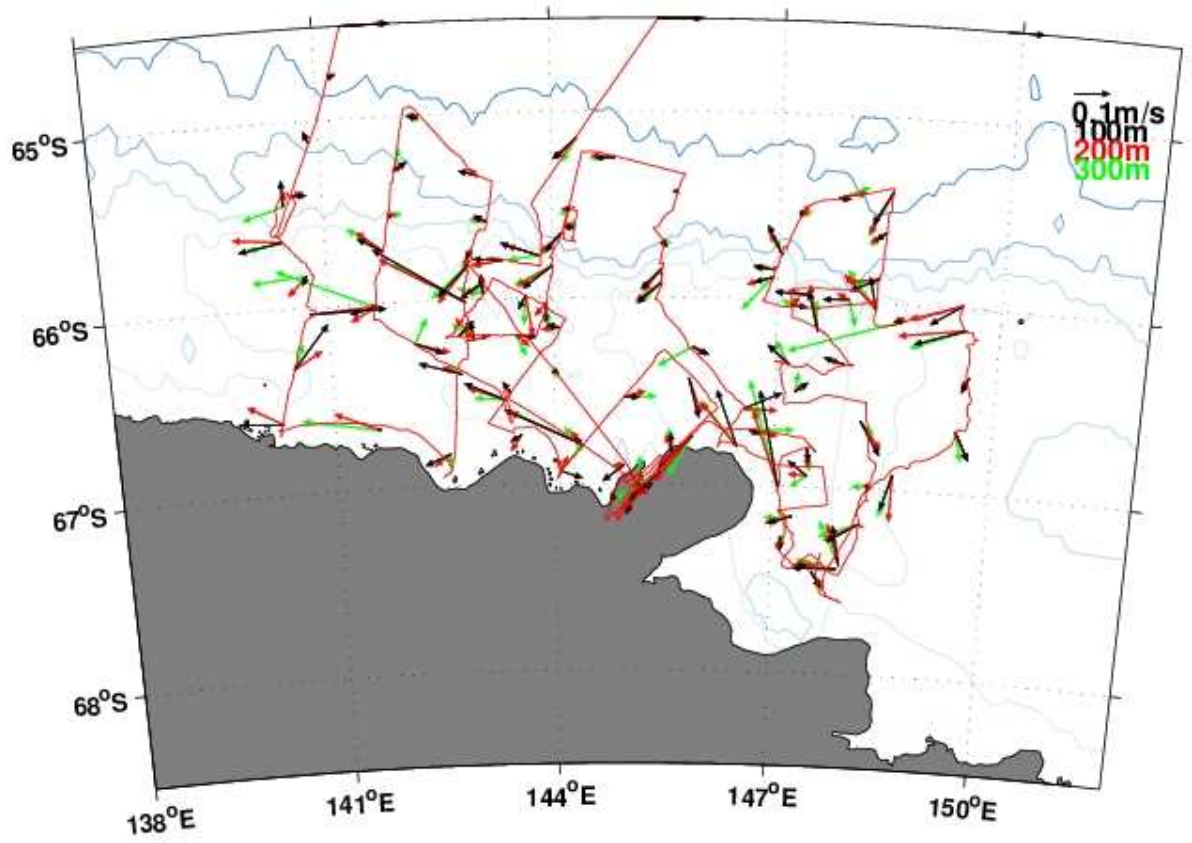

Fig. 4. Ocean currents at depths of 100, 200 and 300m at specific points along the ship track, 6-hour averages, from measurements by the vessel mounted acoustic doppler current profiler. For more detailed ADCP data, see http://currents.soest.hawaii.edu/nbpalmer/.

CTD-mounted upward and downward-looking ADCP systems recorded relative currents on most stations, at a resolution of 10m, with a range of 250m from the CTD, and over 100m profile lengths. Acoustical data quality was normal for the Antarctic environment, but reliance on the earth's magnetic field for current direction and the proximity of our study area to the south magnetic pole resulted in unsatisfactory full water column profiles. While this potential problem was anticipated at the outset, we attempted to address it by allowing a slight, measurable ship drift during station. In combination with altered analysis routines, that technique has yet to yield reliable current velocities. The hull-mounted ADCP relies on differential GPS and is thus not similarly impacted.

Water Sampling and Analyses

With the majority of NBP00-08 stations over the continental shelf and slope, fewer than the 24 samples provided by the SeaBird rosette were typically needed to define the water column structure. Duplicate bottles were therefore closed at the same depth on many casts. Where both bottles were sampled, or duplicate sampling was done to evaluate collection and processing methods, those results have been merged. Attempts were made on most stations to profile and sample within 5m of the sea floor, as indicated by pinger 'HT' in the listing headers. Some sample outliers relative to the CTD profiles have been removed, e.g., high oxygen values on stations 85 and 86. Others have been retained, such as the frequently higher bottle salinity values at the sea surface. The combined profiles and salinity/oxygen samples in this report may provide guidance for users where anomalies remain.

Salinity

Approximately 1200 salinity samples were drawn and processed aboard ship on a Guildline Autosal salinometer in order to monitor CTD conductivity sensor performance and bottle closure depth. Prior to analysis, salinity samples were allowed to equilibrate to the lab temperature, which fluctuated between 22.5 and 23.5°C. Salinity was calculated according to the Practical Salinity Scale of 1978 (UNESCO 1981), using three or more conductivity ratio determinations. Autosal standardization was to IAPSO batch P137 bottled in December 1999, for which we have no strong evidence of significant drift or offset. Because of frequent sampling in intrusions, high gradient regions and near the sea surface, the full rosette salinity data set differs from the corrected CTD salinities by an average of 0.0073, with $\sigma = 0.0430$; a subset of that file for depths below 200 dbar differs by 0.0014, with $\sigma = 0.0279$. Eighteen duplicate salinity samples showed a mean difference of 0.0008, with $\sigma = 0.0010$.

Dissolved oxygen

Water samples were drawn for dissolved oxygen measurements on most CTD/rosette stations, 860 in total, and processed on an automated amperometric oxygen titrator. Basic equipment and methods, and field comparisons with other high-precision titrators are described by Culberson & Huang (1987) and by Langdon & Bitte (1995). The usual corrections were made for reagent blank and volume, along with thiosulfate drift. During the cruise, 91 sets of triplicate samples were collected to check the precision of sampling and titration, yielding an average standard deviation of 0.004 ml/l. Bottle oxygen data were subsequently utilized to adjust CTD profile measurements based on pre-cruise sensor calibration, as noted above. Additional dissolved oxygen measurements, not reported here, were made underway with an ENDECO model 1125 Pulsed Oxygen Sensor, on productivity stations, and in conjunction with onboard incubation experiments. The NBP00-08 bottle oxygen determinations are consistent with prior observations in the same region, with a slight tendency toward higher values near the surface (Fig. 5). This may result in part from our station distribution, including measurements near glacial ice and the Antarctic coastline, and in localized high-productivity areas.

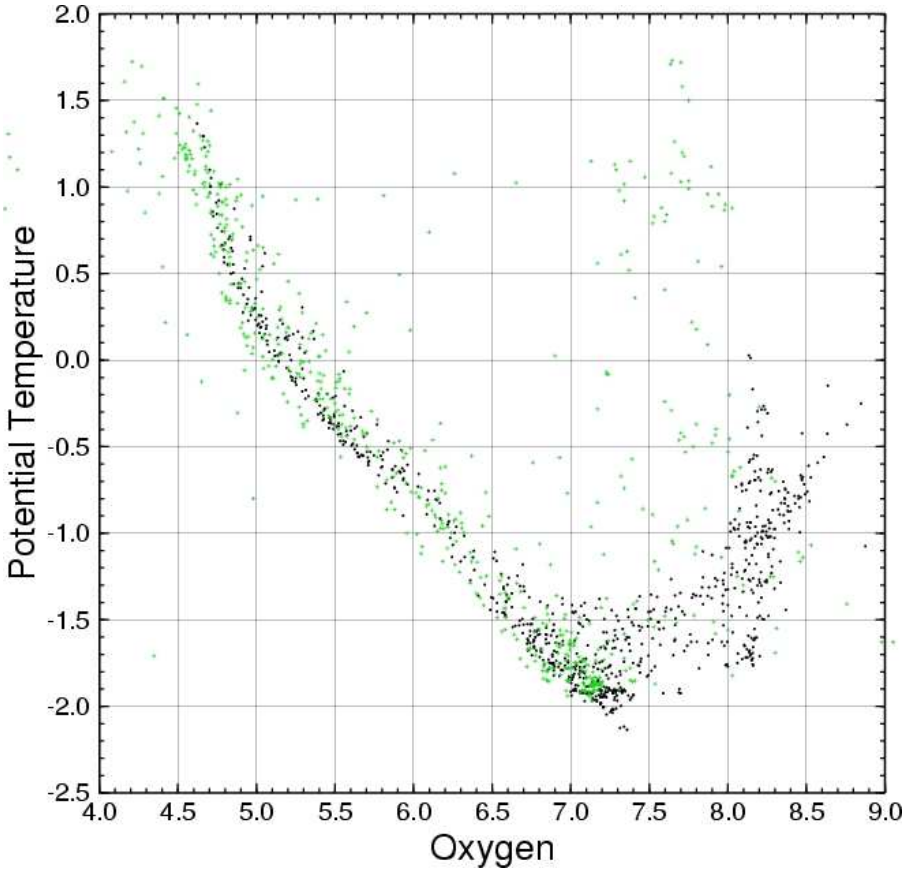

Fig. 5. Dissolved oxygen vs potential temperature, from titrated bottle samples on NBP00-08 (black dots) vs other measurements in the same region (green crosses).

Nutrients

In support of the adjunct biological project, nutrient samples were taken and processed aboard ship by a CSIRO group based in Hobart, Tasmania. About 2100 samples were collected on 147 stations, with a duplicate frozen at –80°C as a backup. Analyses were carried out on an Alpkem system, using data collection and processing software designed by Alpkem and CSIRO. Methods followed Cowley & Eriksen (2000), with cruise standards prepared in Hobart from Ocean Scientific International reference standards, using filtered surface seawater. Quality control samples, prepared by spiking autoclaved surface seawater with nutrients, were also processed on each station. During the cruise a water quality problem with one of the Nanopure systems was detected in the nitrate/nitrite analysis, resulting in the switch to another Nanopure unit and the use of backup samples on some stations.

Duplicate analyses, usually involving samples from two bottles tripped at the same depth, were taken on 18 stations in the study area. From ~120 duplicates, the differences for silicate, nitrate (nitrate+nitrite) and phosphate averaged 0.3, 0.1 and 0.01 µm/l, with σ = 0.5, 0.2 and 0.02, respectively. A few values were edited out, and all nutrients on station 8 were shifted one bottle deeper (from 24-2 to 23-1). While some apparent outliers remain, the nutrient

values are consistent with other available information from the same region, and often reflect the inversions encountered in the regional thermohaline and other fields (Fig. 6).

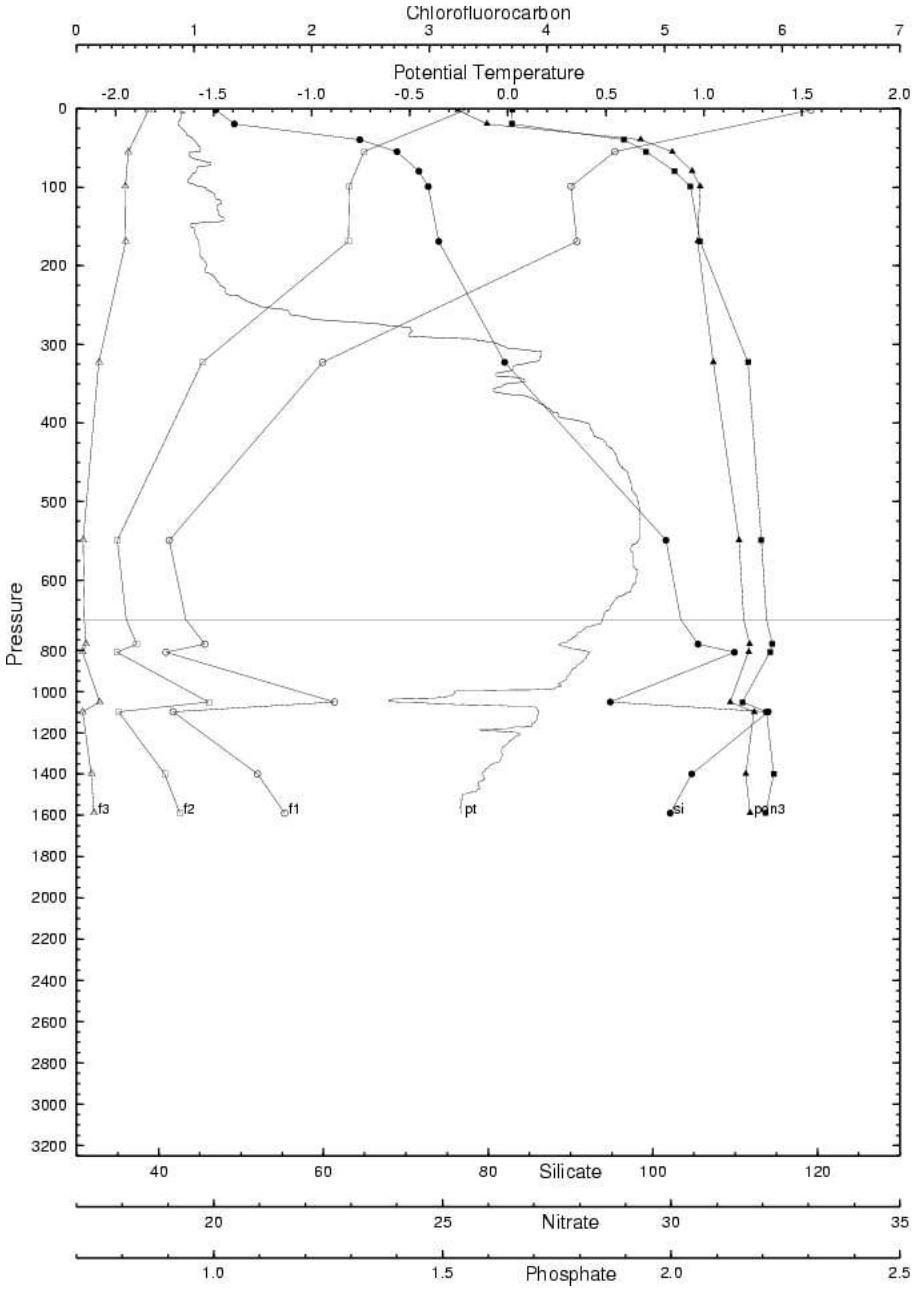

Fig. 6. Example (station 77) of chlorofluorocarbons: CFC-11 (f1); CFC-12 (f2); CFC-113 (f3) and nutrients: silicate (si); nitrate (n3); phosphate (po) from water samples, and CTD potential temperature (pt) vs pressure. Units are picomoles/kg, micromoles/kg and °C.

Oxygen Isotopes

Oxygen isotope measurements were made on a Micromass Multiprep automatic water equilibration system interfaced to a FISONS PRISM III Mass Spectrometer using standard

methods (Craig 1961). All samples were run in duplicate. Precision is estimated to be $\pm$0.03 per mil (1σ) as determined by multiple daily analyses of laboratory standard double deionized water (DDW-2). Instrument linearity and accuracy was determined by comparison of DDW-2 to NBS standard water VSMOW (Vienna Standard Mean Ocean Water), Greenland Ice Sheet Precipitation and Standard Light Antarctic Precipitation. Our accuracy is estimated to be within 0.03 per mil by comparison of measurements of North Atlantic Deep Water with VSMOW.

Chlorofluorocarbon (CFC) measurements

Water sample collection and analysis

More than 1200 CFC (CC13F, CC12F2, C2C13F3) samples were taken on 138 stations. CFC samples were the first samples to be taken from 10 liter Niskin-type bottles with coated internal springs and baked o-rings. Samples were drawn into 100ml precision ground glass syringes, which were capped with stainless steel Luerlock caps and stored in a sink continuously flushed with uncontaminated surface seawater. Tension was maintained on the syringe plunger with rubber bands and the samples were analyzed within 12 hours of collection.

A purge and trap system interfaced to a gas chromatograph (GC) with an electron capture detector was used for analysis (Smethie et al 2000; Bullister & Weiss 1988). Water samples were injected from the syringes through a three-way valve into a calibrated glass volume (~35cc, calibrated to better than 0.1%). The three-way valve and the calibrated volume were flushed with sample water prior to taking the aliquot for analysis. Water in the calibrated volume was subsequently transferred to a glass stripper chamber where dissolved gases were purged with ultra high purity nitrogen, also used as the GC carrier gas. Released CFCs were concentrated by adsorption on a unibeads 2S cold trap at -70° C. The trap was then isolated, heated to 100°C, and the desorbed gases were backflushed into the chromatographic columns using ultra pure nitrogen. A precolumn (stainless steel, 40 inch length, 0.085 inch ID packed with 80-100 mesh Porasil B) and a main column (stainless steel 5 ft length, 0.085 inch ID packed with 60-80 mesh Carobgraph 1AC), were mounted in the GC oven and maintained at a constant temperature of 100°C. The main column was followed by a 0.085 inch ID, 4 inch long stainless steel column packed with 80-100 mesh mol sieve 5A, mounted outside the GC oven and maintained at 50°C, which was valved out of the gas stream after CFC-12 eluted. Its purpose was to separate CFC-12 from N_2O. The detector was operated at 250°C. The chromatographic run required 8 minutes, and total analysis time was 10 minutes per sample.

Air sample collection and analysis

From a single inlet located just forward of the ship's bridge, air samples were drawn through a continuous line of 3/8 inch diameter Dekabon tubing. A KNF Neuberger pump with a teflon-covered rubber diaphragm was used to continuously pump air through the line. Aliquots of air taken from this line for CFC analysis were passed through magnesium perchlorate to remove water vapor, isolated in a calibrated sample loop, and analyzed as for standard gases (see 'Calibration'). Samples were collected when the wind direction was from

the bow to avoid contamination by the ship's atmosphere. Measured concentrations are presented in Table 3, along with average concentrations measured at Cape Grim, Tasmania.

Table 3. Atmospheric CFC concentrations made during the NBP00-08 cruise and by the AGAGE program (Cunnold et al 1997; Fraser et al 1996) at Cape Grim Tasmania from December 2000 – January 2001.

Date	Latitude	Longitude	n	CFC-11 (ppt)	CFC-12 (ppt)	CFC-113 (ppt)
12/24/00	58.90°S	145.33°E	4	259.2±6.2	537.7±2.6	79.9±0.6
12/30/00	65.33°S	143.00°E	3	259.7±1.3	536.8±1.0	80.7±1.5
01/04/01	66.00°S	146.00°E.	4	268.4±2.7*	539.5±2.9	80.3±1.2
01/06/01	65.20°S	145.42°E	5	253.7±1.7	536.4±0.8	79.8±0.7
01/11/01	66.05°S	148.44°E	4	254.7±1.5	537.4±1.6	78.6±0.2
01/17/01	66.48°S	147.33°E	5	258.8±2.0	533.5±2.5	80.6±0.9
average				257.2±2.8	536.9±2.0	80.0±0.8
12/00-1/01	Cape Grim			257.9±0.3	539.8±0.6	81.5±0.2

*The CFC-11 concentration appears too high and the wind direction was not strongly over the bow. This value was not included in the average.

Calibration

The electron capture detector response to different amounts of CFCs was calibrated by filling 10 different sized calibrated loops attached to a multiport valve with a gas mixture (CFCs in nitrogen) of known CFC content. Loops were filled individually and, after relaxation to ambient temperature and pressure, the standard gas was concentrated onto the cold trap and injected into the GC by the same procedure used for water samples. Calibration curves were run every 2nd or 3rd day during the course of the cruise and one of the standard volume loops was run frequently (at least every other hour) to check for drift in the detector response between calibrations. Our standard was calibrated against the SIO 98 CFC calibration scale and the results in this report are on that scale.

Precision and blanks

Duplicate samples have been averaged for this report. Average differences in duplicate samples (n=32) were 0.4% for CFC-12, 0.9% for CFC-11 and 1.5% for CFC-113. Analytical blanks were determined for every 6 or 7 samples and a correction applied. Average analytical blanks were 0.004 pmol/kg for CFC-12, 0.017 pmol/kg for CFC-11 and 0.002 pmol/kg for CFC-113. Sampling blanks are typically 0.003-0.005 pmol/kg, small relative to concentrations measured on this cruise, and thus not applied.

Underway Surface Measurements

A SeaBird thermosalinograph was used to record sea surface temperature (SST) and salinity (SSS) during the cruise. SST (SSS) was adjusted by -0.0382 (+0.199984), the average offset vs near surface (<6m) CTD temperature (salinity). Temperature and salinity data at one minute intervals were edited for spikes and smoothed with a 61-point running average. Results are plotted along the ship track in the study area in figure 7, and as a function of measurement time in figure 8.

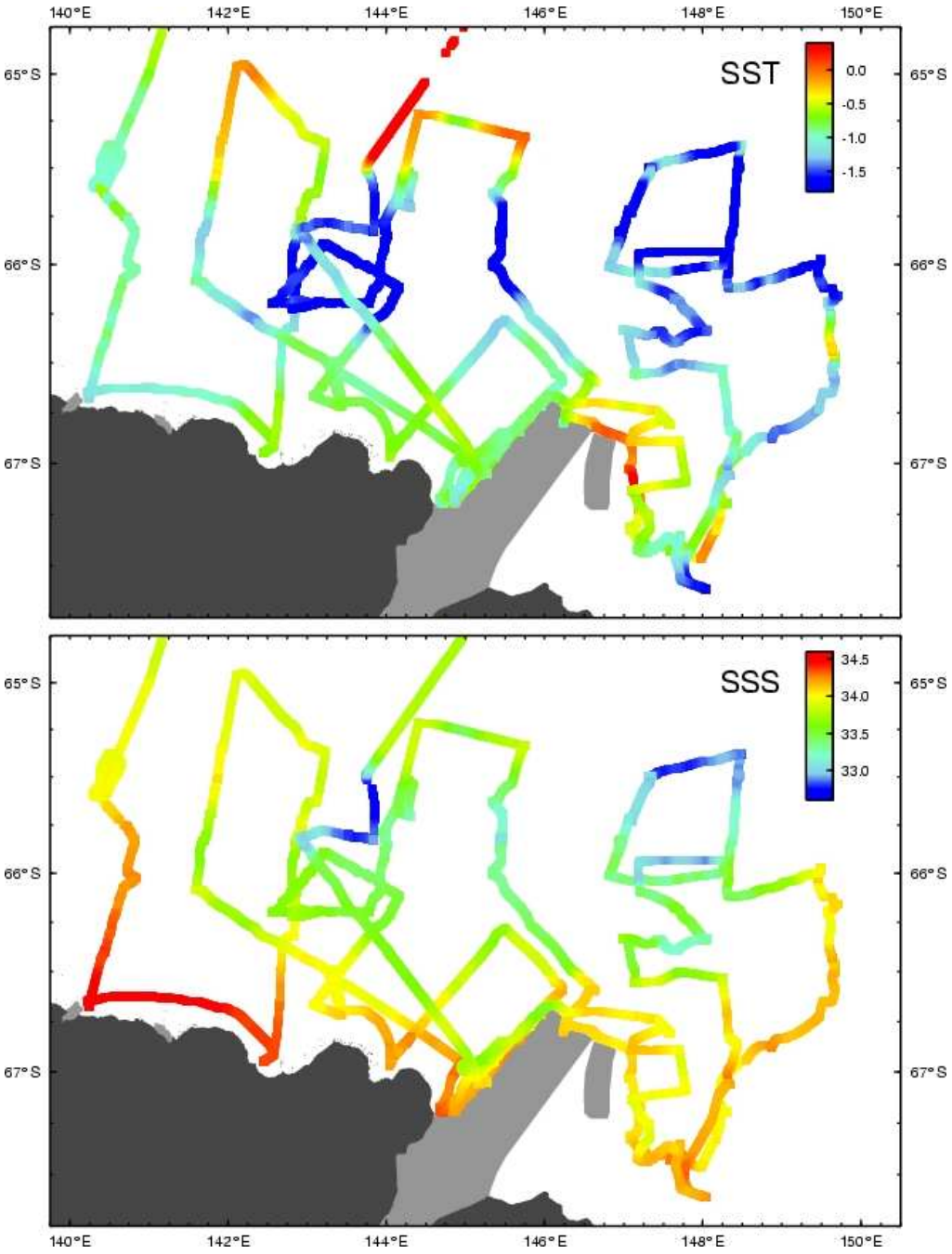

Fig. 7. Underway sea surface temperature and sea surface salinity along the NBP00-08 track in the Mertz study area.

One minute meteorological data files were generated aboard the ship. After rough editing and smoothing as above, wind speed, air temperature, relative humidity and surface pressure in the study area are shown in figures 9 and 10. Wind speed and air temperature were measured ~34m and 17m above the sea surface. Underway sea surface fluorescence measurements are not reported here.

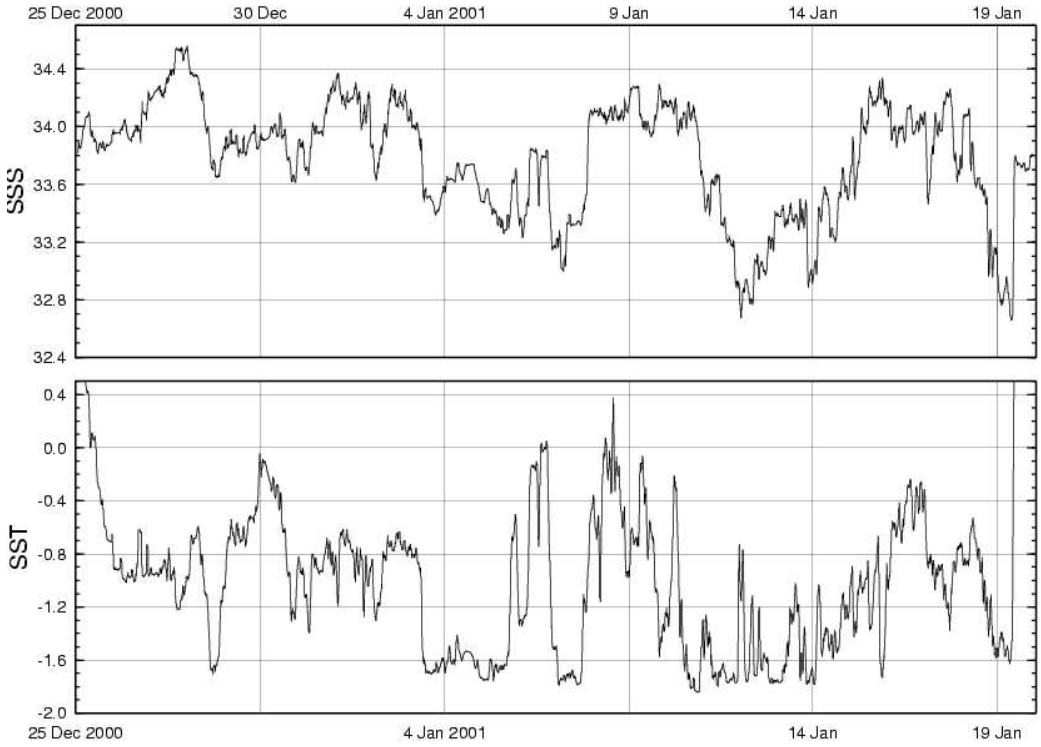

Fig. 8. Underway sea surface temperature and sea surface salinity vs time of measurement along the NBP00-08 track (Figures 2 and 7).

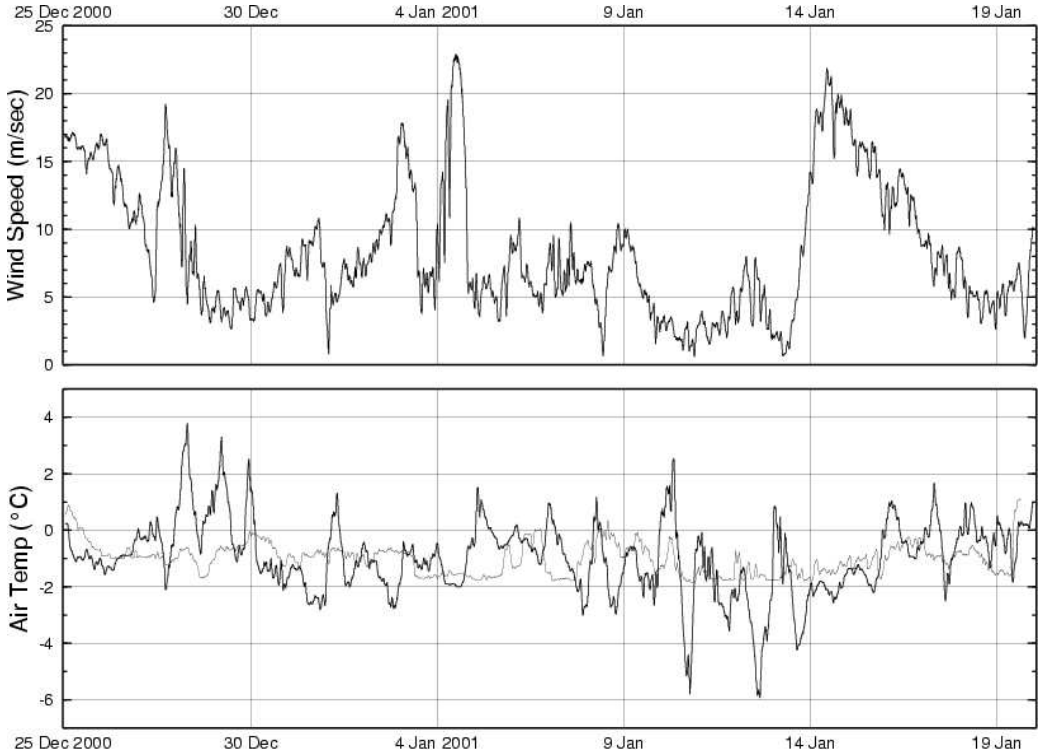

Fig. 9. Wind speed and air temperature along the NBP00-08 track in figure 2. The lighter line in the air temperature panel indicates sea surface temperature.

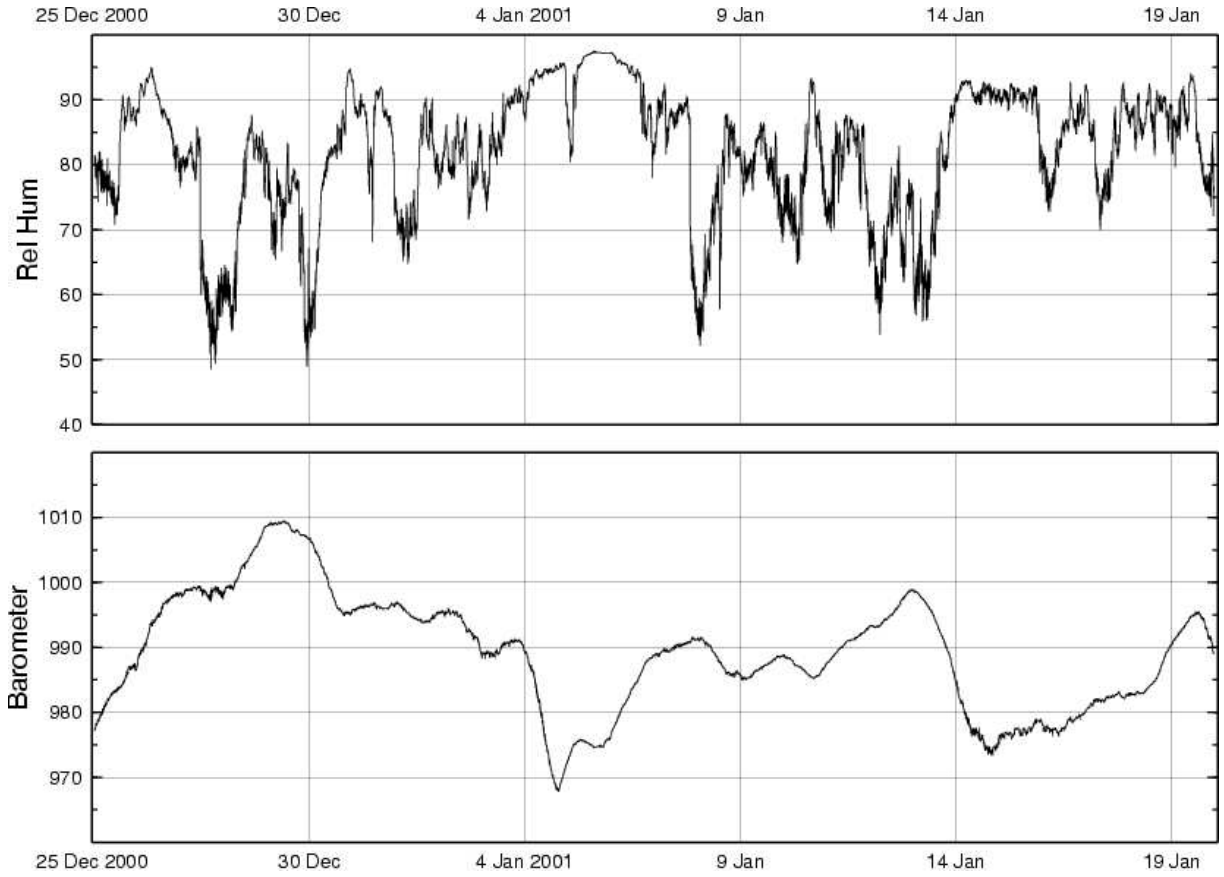

Fig. 10. Relative humidity and surface pressure along the NBP00-08 track in figure 2.

Sea floor depth, also recorded at one minute intervals along the ship track, is shown in figure 11, uncorrected for sound velocity differences from 1500 m/s. The trackline and multibeam bathymetry are archived as noted below, and will be used to update the Chase et al (1987) and Porter-Smith (2003) bathymetric charts of this region.

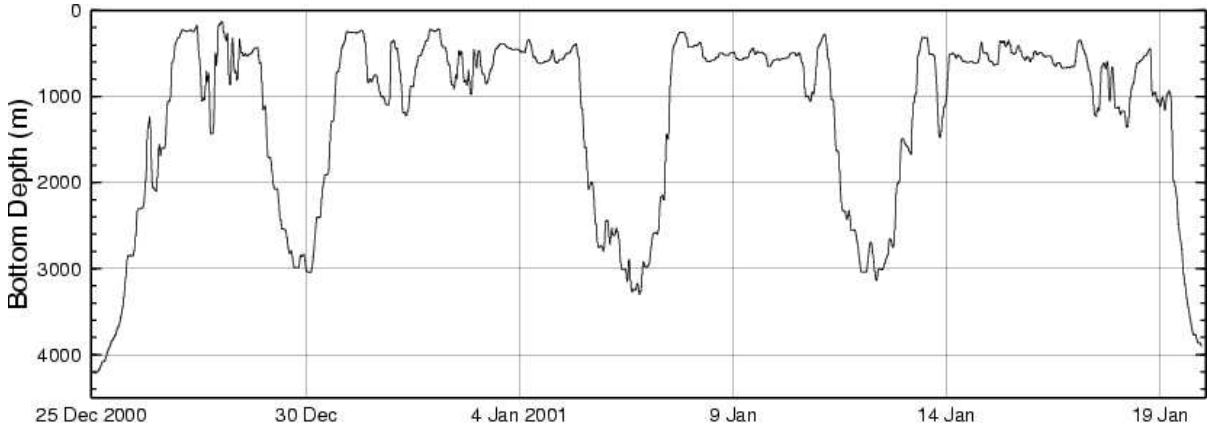

Fig. 11. Sea floor bathymetry along the NBP00-08 track in figure 2.

Acknowledgments
We thank the officers and crew of the *Nathaniel B. Palmer*, Captain J Borkowski, and the Raytheon Polar Services Company (RPSC) led by Party Chief K Newyear. Shipboard CTD/ADCP/salinity/O-18 work was the responsibility of G Schmidt (NASA/GISS), R Guerrero (INIDEP), S Jacobs, G Krahmann, D Thresher (NASA/GISS) and G Williams (Antarctic CRC); dissolved oxygen and primary productivity by C Langdon, R Vaillancourt, M Wara (UCSC), S Green and A Matsuda; CFC sampling and analyses by G Mathieu and D Ho; nutrient sampling and processing by N Johnston, V Latham and R Watson (all CSIRO); geophysical data acquisition by K Nielson (CalTech). We were ably assisted in this work by RPSC technicians A Archer, C Courcier, K Gavahan, D Green, E Horgan, A Hunt, R Liben, K Ludwig, J Otten, J Szelag and J Touchette. CFC data reduction and editing at Lamont by E Gorman and H Lee. Data acquisition and processing was supported primarily by grant OPP-99-09374 from the National Science Foundation to S Jacobs and R Fairbanks. Funding for nutrient work was provided by NSF/OPP via a contract through RPSC. CFC data collection and reduction was supported by NASA Grant #NAG5-7461 and by a cooperative agreement from NOAA through grants NA77RJ0453 UCSIO PO 10156283 and UCSIO PO 10196097-003 (CORC II and ARCHES).

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Station Lists and Plots

The CTD and bottle data are presented in tabular and graphical form for each station, on facing pages. The tabular information, from top to bottom, shows standard level observations during CTD descent through the water column, rosette bottle files when present, and standard level data during CTD ascent, truncated if the single page length is exceeded. On shallow casts (<200m), additional levels are listed. Test station 1, north of the study area, is not included and there was no station 11.

Header fields

SHCRUS = ship and cruise, NP0008 for *Nathaniel B. Palmer* cruise #8 in 2000

STNM = station number and cast mode, with D = downcast, and U = upcast, during which rosette bottles (B) were closed

YEAR/MO/DA = date

GTIME = Greenwich Mean Time, in hours:minutes, at the start (D), bottom (B) and end (U) of each cast

LATITUDE and LONGITUDE = coordinates at GTIME, in decimal degrees, negative in the southern and western hemispheres, from GPS navigation

UDPTH = uncorrected sonic bottom depth in meters, from the Simrad EK500 or Raytheon 3.5 kHz depth recorders, at the start (D), bottom (B) and end (U) of each cast

CDPTH = corrected sonic depth, in meters, using water column averaged sound velocity, calculated from 1 meter CTD data, at the start (D) and end (U) of each cast

DPTHC = CTD cast depth plus HT, in meters. May not equal sonic depth due to different location of the CTD and bottom reflector, drift during station, etc.

HT = distance above bottom at the closest approach of the CTD/rosette to the sea floor, in meters, determined by pinger and/or bottom-contact device

BAROM = barometric pressure, in millibars, from the 1-minute average 'JGOFS' file maintained aboard ship, like the following meteorological observations:

WND = wind direction, degrees true from North

WNS = wind speed, meters/second

AIRTM = air temperature in degrees Celsius

RELH = relative humidity

Data fields

PRES = CTD pressure at the shallowest, standard and deepest levels, in decibars

TEMPCTD = in-situ temperature, International Practical Temperature Scale of 1968 (IPTS-68), in degrees Celsius, as for the other temperature fields

POTEMP, PTEMCTD = potential temperature, in degrees Celsius, from UNESCO (1983)

TE>FRZ, TE>FRS = temperature above the in-situ and sea surface freezing points, from UNESCO (1978)

SALCTD = CTD salinity, Practical Salinity Scale (pss) of 1978

OXYGN = CTD dissolved oxygen in milliliters/liter and micromoles/kilogram, using density at the in-situ potential temperature

SIGMA-0, SIGMA.5, SIGMA-1 = potential density referenced to 0, 500 and 1000 dbar, in kilograms/cubic meter - 1000

SVOL = specific volume anomaly, in 10^{-8} cubic meters/kilogram

GEOPT = dynamic height, in meters, relative to the sea surface
SVELOC = sound velocity, in meters/second, calculated after Chen & Millero (1977)
DPTH = depth in meters converted from pressure, after Saunders (1981)
SALROS = rosette salinity, practical salinity units/scale (pss)
OXROS = dissolved oxygen, in milliliters/liter and micromoles/kilogram, from titrated water samples, after Culberson & Huang (1987)
SIO3, PO4, NO3 = silicate, phosphate and nitrate (+ nitrite) in micromoles/kilogram, after Cowley & Eriksen (2000)
O-18 = oxygen 18, per mil referenced to VSMOW, after Craig (1961)
F-11, F-12, F-113 = Chlorofluorocarbon (CFC-11, CFC-12, CFC-113), picomoles/kilogram
BN = rosette bottle number(s), with four digits where samples have been merged or averaged from two bottles closed at the same depth

CTD Vertical Profiles

Solid and dotted lines indicate salinity (pss), potential temperature (°C) and dissolved oxygen (ml/liter) obtained during CTD descent and ascent, respectively. The vertical pressure scale is expanded above 650 dbar. Rosette bottle salinity and dissolved oxygen values are shown for comparison. Cast coordinates, in degrees and minutes, apply to station start time. An inset highlights the location of each profile within the study area station grid.

Data Archival

The CTD and bottle data in this report are available from the National Oceanographic Data Center. Please refer questions or comments to sjacobs or pmele@ldeo.columbia.edu. Trackline bathymetry, multibeam and other geophysical data will be available via an NSF supported project under the direction of S Carbotte (http://data.ldeo.columbia.edu/world/). ADCP data are available from E Firing at http://currents.soest.hawaii.edu/nbpalmer/. The pCO_2 data are archived at the Carbon Dioxide Information and Analysis Center (www.cdiac.ornl.esd.gov).